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15. Supplementary Notes

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16. Abstract (MAXIMUM 200 WORDS)

The purpose of this study was to identify and investigate technologies that may be effective in reducing soil contamination resulting from current or past U.S. Coast Guard (USCG) small arms firing range (SAFR) activities. The study identified USCG SAFRs and selected those that were either representative of typical USCG activities or were sites with a high probability that corrective measures would be needed in the near future. After the ranges were identified, soil samples were collected and evaluated to determine the effectiveness of physical and chemical treatment processes in removing metal contaminants from the soil. Both physical separation and extraction technologies appear to have merit when applied to the USCG soils. Physical separation and chemical extraction were not effective for all the soils, but each technology was effective for at least one of the soils tested. Electrokinetic remediation technology appears to be effective for all soils. Regardless of the technology applied, all the alternatives will produce a metal-contaminated residual that will require disposal or additional treatment. The volume of this residual produced will depend on the technology applied and the amount of contamination in the soil.

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Executive Summary

One of the primary missions of the United States Coast Guard (USCG) is the enforcement of laws and treaties. To implement this responsibility, many USCG members must be trained in the use of small arms (pistols and rifles). As a result of small arms training, firing ranges have become contaminated with concentrations of lead, copper, and antimony. These metals are toxic, with lead being the primary metal of concern due to its higher concentration. Once the range is no longer used for its intended function, it can be classified as a waste site and be subject to remediation under the Resource Conservation and Recovery Act.

The USCG requested that the U.S. Army Corps of Engineers Waterways Experiment Station research the feasibility of using various technologies to treat soil that has become contaminated as a result of USCG small arms firing range (SAFR) activities. This research included site selection, sample collection, soil characteristics analysis, and laboratory-scale treatment technology evaluation.

The study identified USCG SAFRs and selected those that were either representative of typical USCG activities or were sites with a high probability that some form of corrective measures would be needed in the near future. The four sites chosen for study were the : Training Center in Cape May, New Jersey; Integrated Support Command (ISC), Ketchikan, Alaska; ISC, Kodiak, Alaska; and the Communications Station in New Orleans, Louisiana. After these ranges were identified, soil samples were collected and evaluated in the laboratory to determine the effectiveness of physical and chemical treatment processes in removing metal contaminants from the soil.

The laboratory analyses included identification of soil characteristics such as soil type, metals content, and particle size distribution. These characteristics provide an indication of which remediation technologies are likely to be effective on that particular soil. Soil remediation technologies were the primary focus of the laboratory investigations. These technologies are designed to reduce contaminated soil mass. This is accomplished by either producing a small, highly concentrated contaminated residual and a clean large volume soil mass, or through the removal of the soil's contaminants in their entirety.

The technologies tested on the USCG soils included physical separation, chemical extraction, and electrokinetics. Both physical separation and extraction technologies appeared to have some merit when applied to the USCG soils. Physical separation and chemical extraction were not effective for all four soils, but each technology was effective for at least one of the soils tested. Only the electrokinetic remediation technology appears to be effective for all four soils. Regardless of the technology applied, all the alternatives will produce a metal contaminated residual that will require disposal or additional treatment. The volume of this residual produced will depend on the technology applied and the amount of contamination in the soil.